PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/JP2005/020050	26.10.2005	29.10.2004

International Patent Classification (IPC) or both national classification and IPC
G01N21/35

Applicant
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1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. II Priority

1. ☒ The validity of the priority claim has not been considered because the International Searching Authority does not have in its possession a copy of the earlier application whose priority has been claimed or, where required, a translation of that earlier application. This opinion has nevertheless been established on the assumption that the relevant date (Rules 43*bis*.1 and 64.1) is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-9
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-9
Industrial applicability (IA)	Yes:	Claims	1-9
	No:	Claims	

2. Citations and explanations

see separate sheet

RE SECTION V

1. The present application relates to a waveguide designed for confinement of teraherz radiation for use as a detector, in particular of biomolecules disposed on the waveguide surface preferably with periodic spacing along the direction of the waveguide.

   The following documents are referred to:

   D1=US2002068018; D2=US2004058339;

   D3="Three-dimensional polymer/metal-based resonators for Thz-biosensing"; Nagel et al; Conference Digest of the 2004 Joint 29th International Conference on Karlsruhe, Germany Sept. 27 - Oct. 1, 2004; pages 819-820;

   D4=JP2001074647.

2. CLARITY AND INTERPRETATION OF CLAIMS

   - the present wording of the claims should be amended to include the feature that the electromagnetic waves are located in the Teraherz region of the electromagnetic spectrum which is an essential feature of the subject-matter of the present application as stated in the description on pages 1-2 relating to the technical field and background art of the claimed invention. In addition independent claim 1 is sufficiently broadly worded (sensor comprising "a waveguide, "a portion" suitable for detecting, "an object" which is not comprised in the sensor itself) to reduce merely to a waveguide and to be anticipated by any disclosure of a (e.g. an optical) waveguide.

   - "waveguide for ... disposing an object at a plurality of position thereof". The function of the waveguide is not to dispose an object thereon.

   - the object to be analysed is not a feature of the sensor to which the claims are directed.

3. PRIOR ART

D1 (Figs.1, 4-5, 7) discloses compact devices for remotely detecting via a resonance shift the presence of chemical or biological agents using an electromagnetic micro cavity element or an array or assembly of micro cavity elements which are scaled to function in the visible, infra-red or teraherz region and which are fabricated as monolithic planar devices integrated into a waveguide structure. As shown in Fig. 1 a metal or dielectric surface 1 is textured with a lattice to form micro cavities 2, into which particles of material to be detected 3 can fall to permit sensitive detection via probe beam 4 due to the field enhancement inside the cavity 2. As shown in Fig. 4 a teraherz or optical scale high impedance surface ("Hi-Z surface") is fabricated to create a structure with a resonance frequency and bandwidth determined by geometry in which a coating with a selective gel which adsorbs chemical or biological species concentrates the material to be detected in the region of enhanced electric field. In a variation of this reflective embodiment, a waveguide structure is assembled using the planar reflective structure as the waveguide wall - a radio-frequency probe signal that is coupled into the structure will be affected by the presence of the desired compound, since the waveguide dispersion will be modified by the adsorption of the chemical or biological material by this molecular-controllable radio-frequency structure. According to Fig. 5, a variety of substances with the same detector can be sensed by using a panelized approach having an array of micro cavities 2 each having a different resonant frequency covering the entire spectrum of interest, whether the waves are visible, infrared, or teraherz. According to Fig. 7, the micro cavities 2 are preferably arranged on a planar optical waveguide 12 in which one end 13 of the waveguide serves as the input for the light source 14, and the other end 15 serves as the output for the detector 16 and the micro cavities 2 are in the form of micro spheres 2(a) coated with a material 5 that attracts the agent to be detected 3.

D2 (Figs. 4-6) discloses a Teraherz wave-guide structure for detecting molecules of the polynucleotide A in a sample by means of their hybridisation to polynucleotide sequences B (i.e. a plurality of objects) fixed upon a substrate surface 4 by dropping which together define a test medium - polynucleotide sequences X which are contained in the sample but which are not bound to the complementary

polynucleotide sequences B are removed. The hybridisation results in a change of THz radiation that is transmitted along the waveguide and detected by THz detector 10. In the related embodiment of Fig. 5b the waveguide is a frequency-selective element 20 which has a cutting edge which is strongly displaced when the hybridisation reaction occurs. D2 also discloses generally the technique of detecting a plurality of N of different polynucleotide sequences A (1) . . . , A (N) in a sample by using a plurality N of test media which respectively contain the complementary test polynucleotide sequence B[1] , . . . , B[N] which are fixed as test media are fixed at different sites on or in a substrate and which are detected by means of local-resolution methods. Fig. 6 depicts a 2-D array of wave-guide structures 16 which provide the structure depicted in FIG. 4 for the parallel execution of the method on a high number of samples 1 or with a high number of test media 4 - on each waveguide element of the array, DNA objects are periodically disposed implicitly by dropping.

D3 (Fig. 1) discloses a three-dimensional polymer/metal-based resonator for THz-biosensing which is an improved sensing design to planar waveguide approaches using a thin-film micro strip (TFMS) - the 3D parallel-plate (PP) waveguides are effectively a TFMS line of infinite width having air as a dielectric. The device comprises an Au metallized Si wafer as a substrate, on top of which is deposited a metallized adhesive polyester (PET) film as a dielectric support. For the resonator ground layer a metallized Si wafer is laterally stacked between the emitter and detector chip which resonator is structured with periodically arranged grooves by a wafer saw in the surface of the Si wafer to produce a periodic sequence photonic device that acts like a Bragg reflector with a band-stop behaviour and a narrow transmission band within the stop-band. The air-filled waveguide has a field which is confined at the center of the resonator to a width of only 58 micron which allows probing sample spots of a comparative lateral size - the sample medium will form objects located periodically in the grooves.

D4 (Fig. 7) discloses a sensor plate 1 for analysis of target substance 9 such as protein comprising a hydrophobic film 5 having a plurality of openings forming retainers 7 for the target substance covering an optical waveguide 3.

4. NOVELTY

In view of the interpretation of claims and the disclosure of the prior art above:

Claims 1-10. See D1;

Claims 1-3, 5-7. See D2;

Claims 1-2, 4, 6-9. See D3;

Claism 1-4, 6-9. See D4;

- together claims 1-9 do not meet the requirement of novelty (Art. 33.2 PCT).